

What is claimed is:

1. A radiation detection system capable of detecting a radiation source on or within traffic that can travel within M adjacent traffic ways, where M is an integer equal to or greater than a value of 2, the radiation detection system comprising:
 - 5 a set of $(M+1)$ radiation detector assemblies, individual radiation detector assemblies of the set of $(M+1)$ radiation detector assemblies respectively positioned at each of two sides of each of the M adjacent traffic ways;
 - 10 a set of M controllers, each controller associated with a respective traffic way of the M adjacent traffic ways, each controller coupled to the respective individual radiation detector assemblies positioned at the two sides of the traffic way to which that controller is associated, such that two controllers associated with two adjacent traffic ways couple to the individual radiation detector assembly positioned between those two adjacent traffic ways; and
 - 15 each controller being operable to receive a radiation signal produced from at least one radiation detector assembly coupled to that controller to identify a radiation source present in a traffic way adjacent to the at least one radiation detector assembly.
2. The radiation detection system of claim 1 wherein each radiation detector assembly positioned between adjacent traffic ways is operable to detect radiation from either of the two traffic ways adjacent to that radiation detector assembly.
- 20 3. The radiation detection system of claim 1 wherein the controllers operate independently of each other such that if one controller experiences a failure, at least one non-failed controller associated with at least one traffic way adjacent to a traffic way associated with the failed controller is operable to receive a radiation signal produced from the individual radiation detector assembly coupled to both the non-failed controller and the failed controller.
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4. The radiation detection system of claim 2 wherein each controller is operable to produce a controller output signal indicative of radiation detected by each radiation detector assembly coupled to that controller, and further comprising:

5 a central computer system in communication with the set of M controllers to receive and process the controller output signals from each controller to thereby determine the presence of a radiation source and the traffic way in which the radiation source is present.

10 5. The radiation detection system of claim 4 wherein controller output signals from each controller provide:

15 i) adjusted levels of radiation detected by the radiation detector assemblies coupled to that controller, the level adjusted to compensate for differences in artificial and non-artificial radiation detected by the radiation detector assemblies; and

ii) an identity of each radiation detector assembly associated with the adjusted levels of radiation;

20 the central computer system operable to correlate the adjusted levels of radiation from a plurality of radiation detector assemblies to identify patterns of correlated levels of radiation that indicate the existence of a radiation source within a specific traffic way of the M adjacent traffic ways.

25 6. The radiation detection system of claim 4 wherein the radiation detector assemblies are configured to detect a radiation source on or within vehicles traveling within the traffic ways, and the radiation detector assemblies positioned between adjacent traffic ways include:

30 unshielded radiation detectors exposed to background radiation and vehicle shielding from both adjacent traffic ways; and

a natural background radiation rejection processor operable to adjust the levels of radiation detected by said unshielded radiation detectors so as to compensate for their absence of shielding.

7. The radiation detection system of claim 4 comprising:

a set of M traffic sensors respectively coupled to the set of M controllers, each traffic sensor associated with a respective traffic way and operable to produce a traffic signal when that traffic sensor detects traffic traveling in the traffic way to which that traffic sensor is associated; and

5 wherein the controllers are operable to receive and process the traffic signals associated with their respectively coupled traffic sensors in conjunction with any radiation signals received from respectively coupled radiation detector assemblies to identify the traffic way in which a radiation source is traveling.

10 8. The radiation detection system of claim 7 wherein:

radiation detectors of radiation detector assemblies associated with a traffic way that has a neighboring traffic way are also coupled to the controller associated with the neighboring traffic way; and

15 traffic sensors associated with a traffic way that has a neighboring traffic way are also coupled to the controller associated with the neighboring traffic way, such that in the event of failure of the controller associated with the traffic way associated with the traffic sensor, the controller associated with the neighboring traffic way can receive both a radiation signal and a traffic signal from the radiation detector and traffic sensors associated with the failed-controller traffic way to allow the controller of the 20 neighboring traffic way to detect a radiation source in the failed controller traffic way.

9. The radiation detection system of claim 7 wherein the set of M traffic sensors include at least one of a speed sensor, an infrared sensor, a motion detector, and a light beam detector.

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10. The radiation detection system of claim 4 wherein each radiation detector assembly positioned between adjacent traffic ways comprises:

 a radiation detector operable to detect radiation from the traffic ways on either side of the radiation detector; and

30 an amplifier module coupled to the radiation detector and operable to receive the detected radiation as an electrical signal from the radiation detector and to process

the detected radiation to produce the radiation signal for transfer from the radiation detector assembly to the controllers coupled to that radiation detector assembly positioned between adjacent traffic ways.

- 5 11. The radiation detection system of claim 10 wherein each radiation detector assembly positioned between adjacent traffic ways includes a first radiation detector and a second radiation detector; and the amplifier module comprises a single shared preamplifier coupled to the first radiation detector and to the second radiation detector and operable to receive as 10 electrical signals the radiation detected by the first and second radiation detectors, the single shared preamplifier further including a first radiation signal output interface and a second radiation output signal interface in communication with respective controllers associated with the two traffic ways adjacent to the radiation detector assembly.
- 15 12. The radiation system of claim 11 wherein the first radiation detector is a Gamma radiation detector and the second radiation detector is a Neutron radiation detector.
13. The radiation detection system of claim 12 wherein the Gamma radiation detector is an unshielded Gamma radiation detector.
- 20 14. The radiation detection system of claim 12 further including a third radiation detector that is also a Gamma radiation detector, and wherein the Neutron detector that is coupled to both controllers associated with the traffic ways adjacent to the radiation detector assembly.
- 25 15. The radiation detection system of claim 14 wherein the first radiation detector and the third radiation detector are arranged back to back with each other and wherein each provides a shielding effect of background radiation with respect to the other.
- 30 16. The radiation detection system of claim 15 further including shielding disposed on a back side of each of the first and third radiation detectors to shield each of the first

and third radiation detectors from background Gamma radiation in a direction of a back side of each of the first and third radiation detectors.

17. The radiation detection system of claim 12 wherein respective controllers
5 associated with the two traffic ways adjacent to the radiation detector assembly are each coupled to receive radiation signal data from the Gamma radiation detector and from the Neutron radiation detector linked to a common controller, and wherein the respective controllers are operable to statistically correlate Gamma and Neutron radiation levels in order to have less false alarms for detection of radioactive isotopes
10 which emit both Neutron and artificial Gamma radiation.
18. The radiation detection system of claim 10 wherein the amplifier module comprises a first preamplifier and a second preamplifier, each of the preamplifiers having a radiation signal output interface in communication with one of the controllers
15 associated with each of the two traffic ways adjacent to the radiation detector assembly and operable to receive the detected radiation from the radiation detector and to process the detected radiation into respective radiation signals for transfer to the respective controller with which that preamplifier is in communication.
- 20 19. The radiation detection system of claim 10 further comprising:
a natural background radiation rejection processor operable in conjunction with the amplifier module to receive a level of radiation detected by the radiation detector and to apply a natural background rejection signal processing technique to the level of radiation to differentiate between changes in the radiation caused by non-natural
25 radiation sources and changes in the radiation caused by naturally occurring radiation sources such that each of the detector assemblies positioned between adjacent traffic ways does not require shielding from background radiation.
20. The radiation detection system of claim 1 wherein each radiation detector
30 assembly positioned between two adjacent traffic ways comprises:

a unshielded Gamma radiation detector operable to detect radiation from the traffic ways on either side of the radiation detector assembly.

21. The radiation detection system of claim 20 further comprising:

5 a natural background radiation rejection processor operable in conjunction with the unshielded Gamma radiation detector to receive radiation signals from the radiation detector representative of Gamma radiation incident on the unshielded gamma radiation detector and to apply a natural background rejection signal processing technique to the radiation signals to differentiate between changes in radiation caused
10 by non-natural radiation sources and changes in the radiation caused by naturally occurring radiation sources.

22. The radiation detector of claim 21 wherein each controller includes a natural background radiation rejection processor.

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23. The radiation detection system of claim 1 wherein:

the set of $(M+1)$ radiation detector assemblies are disposed in a substantially planar manner with respect to each other to define a radiation detector array substantially perpendicular to the M adjacent traffic ways.

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24. The radiation detection system of claim 23 wherein the radiation detector assemblies include an unshielded Gamma radiation detector that includes a natural background radiation rejection processor operable in conjunction with the at least one radiation detector in the radiation detector assemblies to receive levels of radiation detected by the radiation detector and to apply a natural background rejection signal processing technique to the radiation signals to differentiate changes in a level of radiation caused by non-natural radiation sources as compared to changes in a level of radiation caused by naturally occurring radiation sources, such that the detector assemblies positioned between adjacent traffic ways do not require shielding from
25 background radiation.

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25. The radiation detection system of claim 2 wherein the radiation detector assemblies positioned between adjacent traffic ways include unshielded Gamma radiation detectors.

5 26. The radiation detection system of claim 1 wherein every Nth radiation detector assembly includes a Neutron radiation detector coupled to controllers associated with the traffic ways adjacent to that radiation detector assembly, wherein N is an integer greater than 1.

10 27. The radiation detection system of claim 1 wherein the radiation detector assemblies are configured to detect a radiation source on or within vehicles traveling within the traffic ways, and comprising P radiation detector assemblies positioned at each of two sides of at least some of the M adjacent traffic ways, where P is an integer greater than one, each of said P radiation detector assemblies positioned on top of one another to obtain a desired height required for detecting radiation sources in vehicles that extend to a height above the radiation detection capability of a single radiation detection assembly.

15 28. A radiation detection system capable of detecting a radiation source, the radiation detection system comprising:

20 a first radiation detector;

 a second radiation detector;

 a third radiation detector;

 the first radiation detector and second radiation detector defining a first traffic

25 way;

 the second radiation detector and third radiation detector defining a second traffic way;

 a first controller coupled to the first radiation detector and coupled to the second radiation detector, the first controller operable to identify a radiation source

30 within the first traffic way when at least one of the first radiation detector and the

second radiation detector detect the radiation source passing through the first traffic way; and

5 a second controller coupled to the second radiation detector and coupled to the third radiation detector, the second controller operable to identify a radiation source within the second traffic way when at least one of the second radiation detector and the third radiation detector detect the radiation source passing through the second traffic way.

10 29. The radiation detection system of claim 28 wherein the second radiation detector is an unshielded Gamma radiation detector.

15 30. The radiation detection system of claim 28 wherein each of the first and second controller include a respective natural background radiation rejection processor operable in conjunction with the controller to receive levels of radiation detected by the second radiation detector coupled to those controllers and to apply a natural background rejection signal processing technique to the levels of radiation to differentiate between changes in the radiation caused by non-natural radiation sources and changes in the radiation caused by naturally occurring radiation sources to identify which of the first and second traffic ways contains the radiation source.

20 31. A method for operating a radiation detection system to detect a radiation source on or within traffic that can travel within adjacent traffic ways, the method comprising: detecting a vehicle traveling in a traffic way of the adjacent traffic ways; receiving a radiation signal from an unshielded radiation detector disposed

25 within a radiation detector assembly positioned between the adjacent traffic ways; and in response to detecting the vehicle and receiving the radiation signal, applying a natural background rejection signal processing technique to the radiation signal to differentiate between changes induced in radiation produced by naturally occurring radiation sources received by the unshielded radiation detector due to a position of the vehicle in relation to the unshielded radiation detector and changes in radiation caused by a non-natural radiation source that may be within the vehicle, the natural

background rejection signal processing technique producing an output signal indicating whether or not the vehicle contains the non-natural radiation source.

32. The method of claim 31 wherein there are M adjacent traffic ways, where M is an integer equal to or greater than a value of 2, and wherein the radiation detection system comprises a set of (M+1) radiation detector assemblies, individual radiation detector assemblies of the set of (M+1) radiation detector assemblies respectively positioned at each of two sides of each of the M adjacent traffic ways and a set of M controllers, each controller associated with a respective traffic way of the M adjacent traffic ways, each controller coupled to the respective individual radiation detector assemblies positioned at the two sides of the traffic way to which that controller is associated, such that two controllers associated with two adjacent traffic ways couple to the individual radiation detector assembly positioned between those two adjacent traffic ways; and wherein receiving a radiation signal comprises:
 - 15 operating controllers of traffic ways adjacent to the radiation detector assembly containing the unshielded radiation detector that produced the radiation signal to each receive the radiation signal to identify the non-natural radiation source present in the vehicle in the traffic way adjacent to that radiation detector assembly.
- 20 33. The method of claim 32 comprising operating each radiation detector assembly positioned between adjacent traffic ways to detect radiation from either of the two traffic ways adjacent to that radiation detector assembly.
- 25 34. The method of claim 33 comprising operating the controllers independently of each other such that if one controller experiences a failure, at least one non-failed controller associated with at least one traffic way adjacent to a traffic way associated with the failed controller operates to receive a radiation signal produced from the individual radiation detector assembly coupled to both the non-failed controller and the failed controller.

35. The method of claim 33 comprising operating each controller to produce a controller output signal indicative of radiation detected by each radiation detector assembly coupled to that controller; and

5 operating a central computer system in communication with the set of M controllers to receive and process the controller output signals from each controller to determine the presence of the non-natural radiation source and the traffic way in which the non-natural radiation source is present.

36. A method of operating a radiation detection system capable of detecting a radiation source on or within traffic that can travel within M adjacent traffic ways, where M is an integer equal to or greater than a value of 2, the method comprising:

10 operating a set of $(M+1)$ radiation detector assemblies, individual radiation detector assemblies of the set of $(M+1)$ radiation detector assemblies respectively positioned at each of two sides of each of the M adjacent traffic ways, such that at least 15 one radiation detector assembly detects a radiation source traveling within at least one of the M adjacent traffic ways;

15 operating a set of M controllers, each controller associated with a respective traffic way of the M adjacent traffic ways, each controller coupled to the respective individual radiation detector assemblies positioned at the two sides of the traffic way to 20 which that controller is associated, such that two controllers associated with two adjacent traffic ways couple to the individual radiation detector assembly positioned between those two adjacent traffic ways; and

20 each controller operating to receive a radiation signal produced from at least one radiation detector assembly coupled to that controller to identify a radiation source 25 present in a traffic way adjacent to the at least one radiation detector assembly.